

ULTRA-PORTABLE

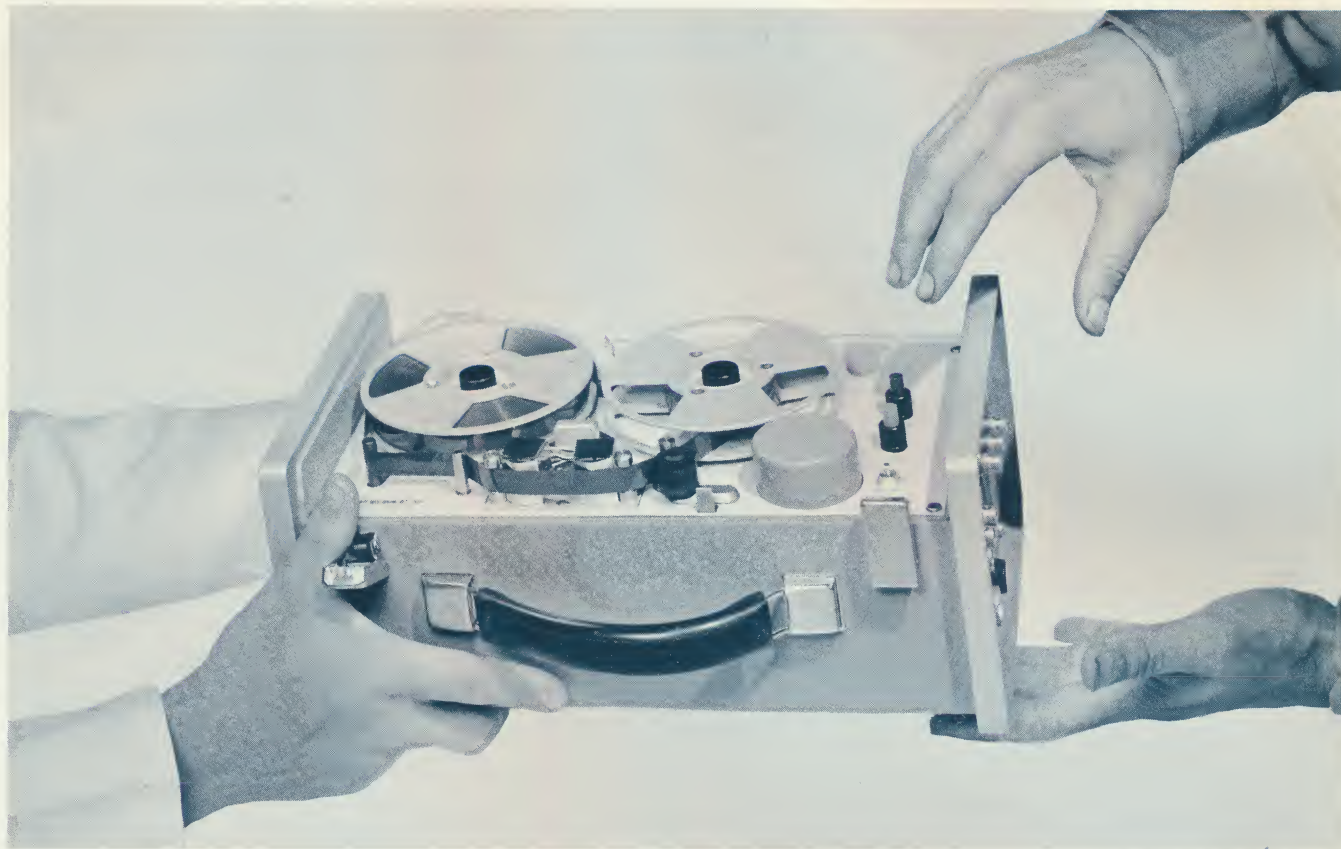
PEMCO MODEL 110

SCIENTIFIC DATA RECORDER

The smallest general-purpose instrumentation recorder/reproducer with full 14-channel capability



THE PEMCO MODEL 110 ULTRA-PORTABLE SCIENTIFIC DATA RECORDER



The Model 110 has achieved a unique position in the field of precise, high-accuracy data-acquisition equipment as the world's smallest general-purpose recorder/reproducer. It combines laboratory performance capabilities and reliability with light weight, low power consumption and unusual flexibility, and readily adapts to a broad range of portable and mobile applications, operating in any position at altitudes up to 70,000 feet. Up to 14 channels of data ranging from DC to 100 KC are recorded *and* reproduced using standard IRIG or extended-bandwidth FM and Direct techniques. Tape speeds range from 15/16 to 60 inches per second, and tape width can be $\frac{1}{4}$, $\frac{1}{2}$ or 1 inch.

All of these features (except 14-channel reproduce*) are provided in a single rugged carrying case of only $\frac{1}{3}$ - $\frac{2}{3}$ cubic foot volume and weighing a mere 17-24 pounds including tape. Recorder size, weight and power consumption are only about $\frac{1}{5}$ that of

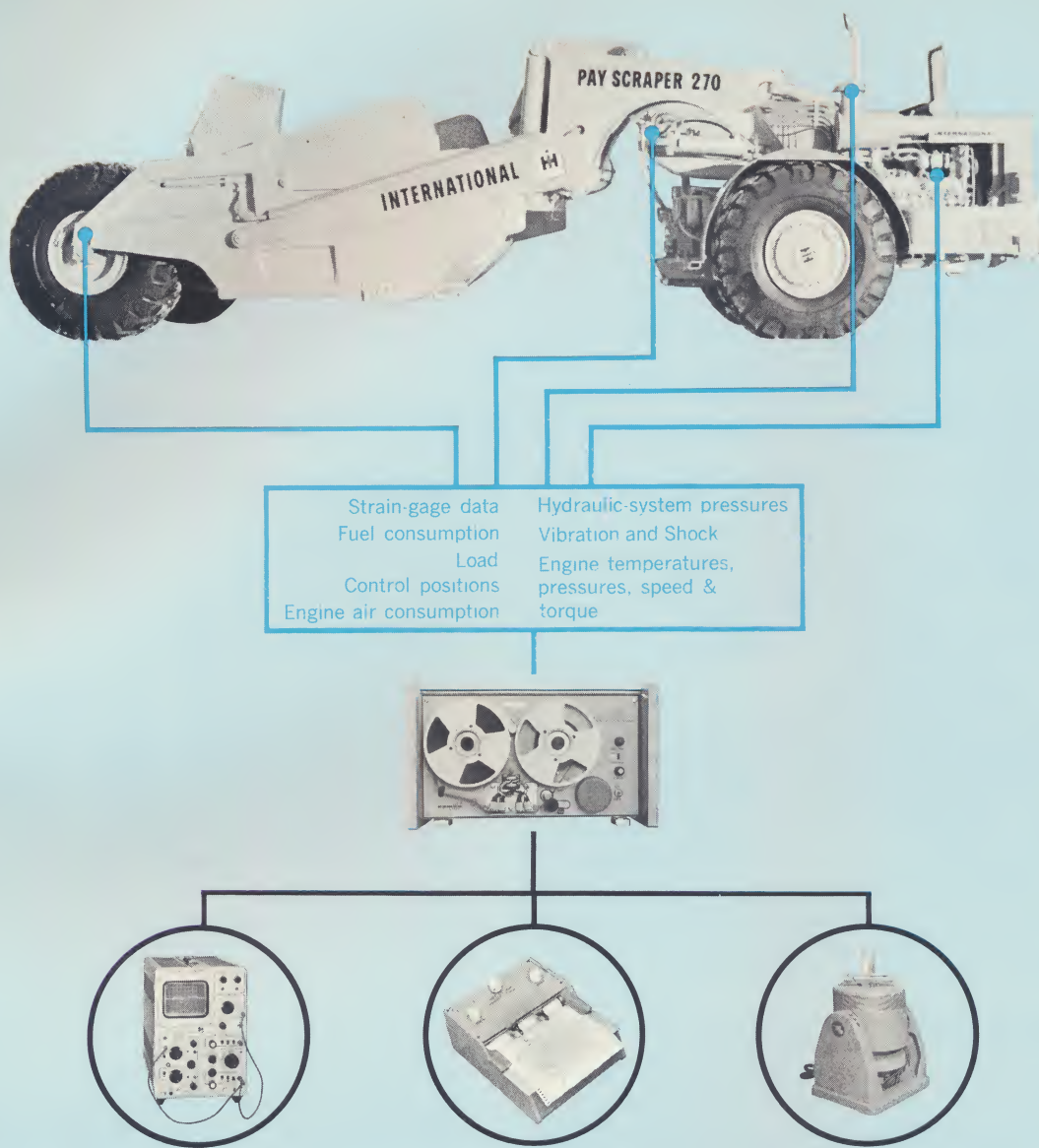
* 14-channel record/reproduce systems require Model 20 Auxiliary 14-channel Reproduce Unit.

conventional portable or mobile recorders. Application versatility is increased substantially by a choice of either DC or AC models and compact accessories which permit operation from a self-contained power pack, standard automobile batteries, aircraft power or 117/220 volt lines.

Although many customers use their Model 110's primarily for portable and/or mobile data acquisition and reduce their data on standard lab reproducers, an increasing number use the 110 for both recording *and* reproducing test data. Modular design enables individual users to get just the capability needed for their present application plus expandability for easy alteration to fit future test needs.

Equipped with appropriate digital heads, the Model 110 has also been successfully employed to record NRZ digital data in a number of systems, some IBM compatible, which do not require inter-record gaps. Digital electronics, when required, are handled as specials.

On the cover: University of California scientists use Pemco Model 110 to record driver electroencephalograms in response to highway hazards. UCLA program evaluated capabilities of helmet for monitoring astronaut brain waves in extended space flights.

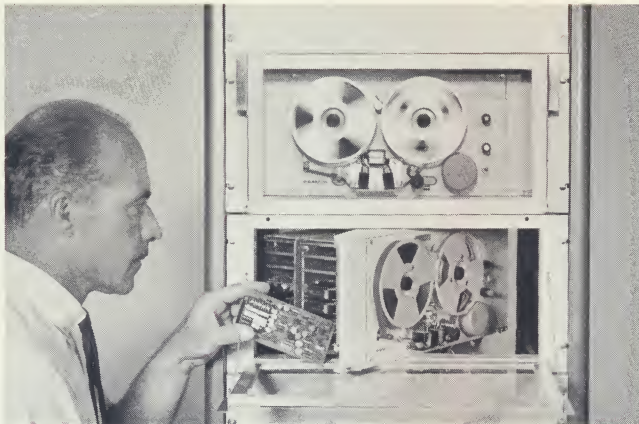


TAPE: THE MODERN WAY TO RECORD TEST DATA

The Model 110 Recorder/Reproducer brings the advantages of magnetic tape to your critical test situations. A tape recorder is the logical extension of strain-gage or vibration instrumentation, even though you may already use photographic or pen oscillograph recorders. Voltages from transducers such as vibration and pressure pick ups, strain gages, tachometers, flow meters, etc., are recorded in precise time relationship. Rather than attempting to repeat expensive, perhaps even destructive tests, tape can re-create the event for you—usually at far less cost. Tape can “run” a test over and over for analysis, to demonstrate performance-goal attainment to customers or management, or to show deficiencies which should be corrected prior to further tests. A voice description and actual test sounds

can be taped for explanation and identification, or as a vital record for noise-reduction efforts.

With your tests captured on tape you can scan them with an oscilloscope, then reproduce only the important portion of the data on Polaroid photographs, or obtain a graphic record with a chart-type recorder. And, where test frequencies exceed graphic-recorder-response capabilities, you can stretch the time base. Data recorded at fast speeds can be played back at slow speeds to reduce the frequencies. Taped vibration data are often used for programming shake tables to re-create test environments in the laboratory. Taped data save manpower. Data on tape are adaptable to automatic data-reduction techniques. Slow intermediate manual steps required with graphically obtained data can be eliminated for dramatic improvements in the time required to look at meaningful data.



Rack-mounted 110's are center-pivoted to allow front access to the electronics, signal, power, and remote-control connections, and to the drive system. Accessibility is essential for trailer, blockhouse, flying-laboratory, and shipboard uses.



No complex procedures are required to confuse the busy test operator. Just turn on the recorder to acquire data. Remote control shown is for a two-transport system.

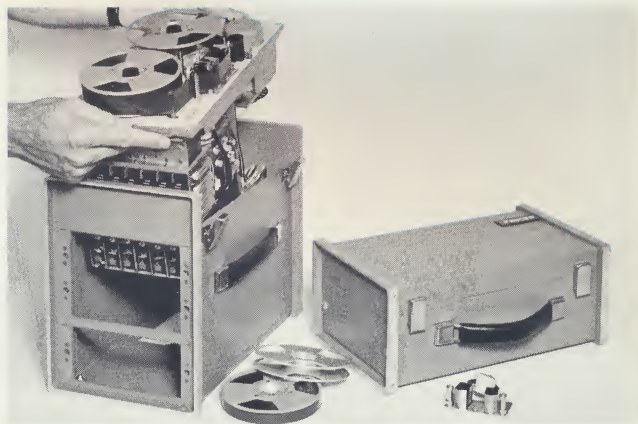
ADAPTABLE The purchaser of a Pemco Model 110 gets a basic test instrument with built-in capabilities to handle today's specific test needs or tomorrow's new requirements. Speeds ranging from 15/16 to 60 inches per second permit matching required frequency response to desired recording time. Electrical signals from DC to 100,000 cps can be recorded with either Direct or FM-Recording techniques, depending on data requirements. Where space is limited the recorder can be operated in any position, with or without shock mount. Optional rack mount facilitates integration into rack-mounted systems.

COMPATIBLE Tapes recorded on a Model 110 can be reproduced on the same or another Model 110. A tape recorded on the 110 needs only to be transferred to an NAB reel to permit its reproduction on other standard tape equipment. Track spacing, recording characteristics, and tape speeds are all compatible with the IRIG* standards to which most tape-recording equipment is constructed. Tapes recorded at remote field locations can be sent to the laboratory for analysis while the

* Inter Range Instrumentation Group: White Sands Proving Ground.



Tapes recorded on Model 110's are compatible with other recording equipment which may be used in data analysis, often at far-distant locations. Accessory Tape Spooler loads or unloads 110 reels from NAB reels up to 14 in. dia.

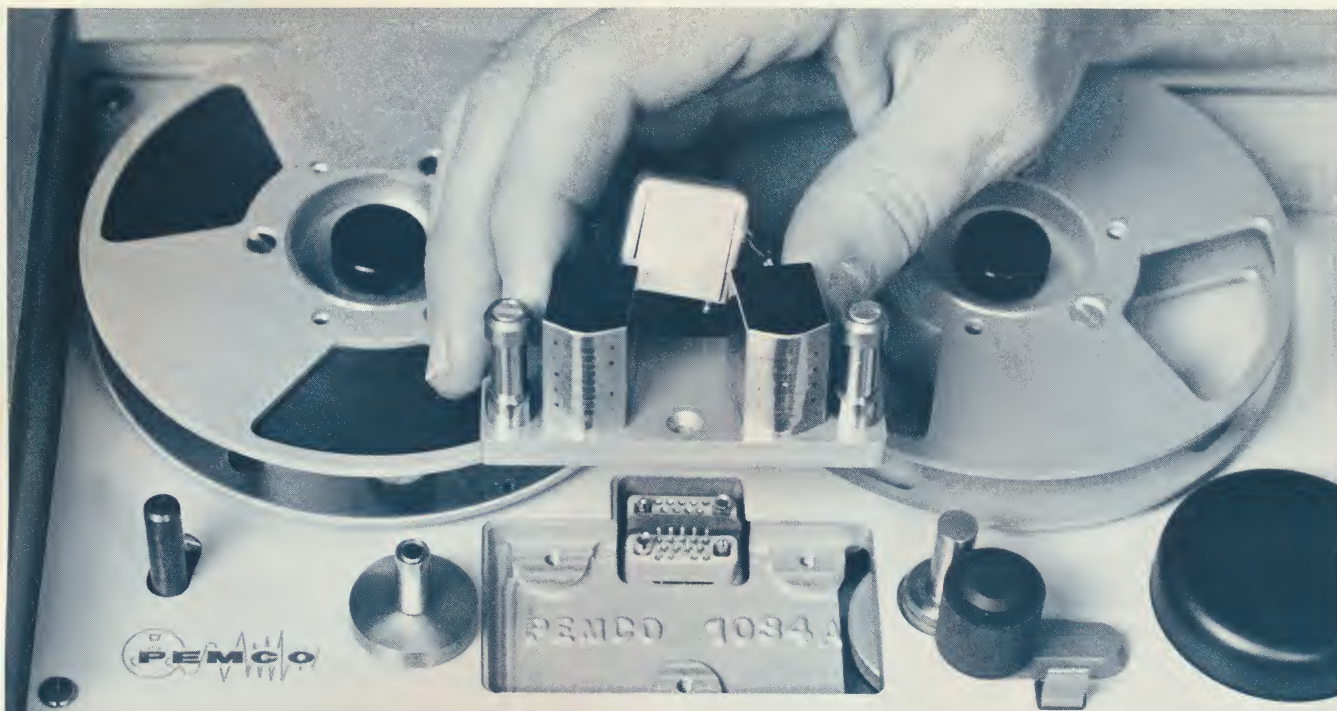


Modular construction of recorder permits expansion to meet tomorrow's test requirements. This recorder has just been enlarged from seven to 14-channel capability.

tape recorder remains at the test site, acquiring additional data. And, unlike photographic-recording techniques which require development to see whether data were obtained, tape can be played back immediately at the test site to determine that the desired data are on the tape. Data can be monitored off the tape as the test progresses for positive assurance that the information is being captured.

EXPANDABLE Modular construction permits expansion from a one-channel record-only instrument to as many as 14 channels of record and reproduce. Simple reel, tape-guide, head and electronics changes are easily accomplished within the expandable packaging system. Where extended tests required longer recording times, systems have been delivered with two Model 110 transports which operate in sequence.

CONTROLLABLE Easier to operate than most home recorders, the 110 can be controlled by the pilot or test-vehicle occupant without special instruction. Or, if the test is an unmanned one, a simple timer-sequencer or radio-control link can be used to initiate recorder functions. Remote controls can be wired so that only one switch operates the recorder.



Precision heads are installed or removed without adjustment. The head baseplate is self-locating on the tape-transport chassis.

ANALOG RECORDING METHODS

Direct recording puts data time/amplitude relationships directly onto the tape. Because carriers or coding are not used, direct recording packs the greatest number of data cycles onto each inch of tape. High-frequency bias allows recording from 100 cps to 100,000 cps at 30 inches per second tape speed. Direct recording is also used for broad-band FM/FM telemetry signals which may contain as many as 18 data-bearing subcarrier frequencies.

FM — Carrier recording uses the data voltages to modulate a carrier frequency, recording the modulated carrier onto the tape, and overcoming the two basic limitations of Direct recording; the inability to record very low frequencies and the amplitude instability caused by tape drop-outs. Frequency response from DC (zero cycles/second) to 10,000 cps at 30 ips permits recording strain-gage and vibration data and other low-frequency phenomena, especially where transients and instantaneous amplitude values must be faithfully reproduced.

FEATURES

Records and reproduces electrical signals from DC to 100 KC Any electrical signal within the input-sensitivity range of the recording electronics can be recorded on tape. This includes simple, complex steady-state and transient signals in the DC to 100-kc range with the tape moving at 30 ips. Within this range the Pemco Model 110 records and reproduces with laboratory accuracy. Frequency response, a direct function of tape speed, is proportionately reduced at slower speeds. IRIG-

standard and extended-bandwidth direct and FM-carrier recording techniques are used. Extended-bandwidth capabilities which double frequency response at any speed up to 30 ips, coupled with careful use of the 1,000 feet of tape available, allow recording most tests on a single reel. Reel size encourages economical use of tape during check-out and calibration procedures—procedures which often consume vast quantities of tape where larger reels are provided.

Up to 14 channels, direct or FM-carrier, record or reproduce Standard Model 110 units provide up to 14 channels of record-only or record and reproduce, depending on tape width and head configuration. Up to 7 channels are available on ½-inch tape; up to 14 channels are available on 1-inch tape. Recording modes can be all-direct, all-FM, or mixed to meet test needs. Standard multiplexing techniques can be used to increase the data-recording capacity of the available tracks.

Precision recording and reproducing heads Tapes recorded on Pemco Model 110 recorders can be played back on other reproducing equipment because all Pemco heads are made to IRIG standards. Track widths, spacing, azimuth, and gap scatter are standard. The heads are manufactured to extremely close tolerances under rigid quality-control inspection procedures. Heads retain perfect performance when removed and reinstalled as they are self-locating and require no adjustment or alignment.

Tape speeds Standard tape speeds are 15/16, 1⅞, 3¾, 7½, 15, 30, and 60 inches per second. The drive system which supplies these speeds is different in the DC and AC models. The DC model obtains its ±0.20% speed stability with a closed-loop DC speed



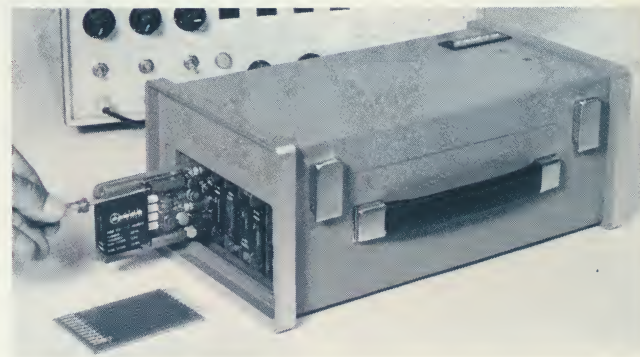
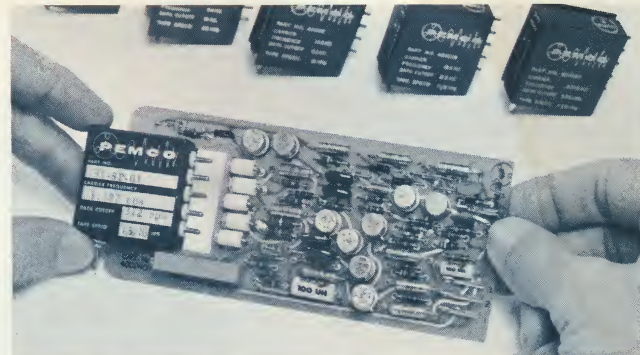
Speed change is accomplished through the bottom access opening by a simple belt or switch change, depending on model.

control servo system. A perforated disc on the DC drive motor interrupts the photocell output to provide pulses for comparison in the servo reference amplifier. Motor-speed changes are instantly detected and correction signals applied to maintain the correct speed. Speed stability is maintained over a wide range of input-power and temperature variations. DC models are available with two-, three-, or four-speed capability with a selection of standard speeds as shown in the specifications. The AC model, often chosen for fixed-test situations, uses a single-speed hysteresis-synchronous motor and belt changes to provide two speeds with $\pm 0.10\%$ speed stability. Special speeds are available on DC and AC models as optional extras.

Rewinding recorded tapes is accomplished with a built-in rewind motor (optional). Many users prefer to keep recorder weight and power consumption at an absolute minimum and use the accessory tape spooler for rewinding their tapes. The accessory spooler is also used for loading the Pemco reels from standard NAB reels or transferring 110-recorded tapes to NAB reels for data reduction on other equipment.

When improved signal-to-noise ratio or dynamic range are required, optional flutter compensation can be provided. It requires one track on the tape and increases normal system S/N ratios approximately 6 db.

When extreme accuracy and improved signal-to-noise ratio plus freedom from the effects of tape-speed variations are required, a reference track can be recorded on the 110 to permit reproduction of the tape on various high-performance playback machines made by other manufacturers. Such equip-



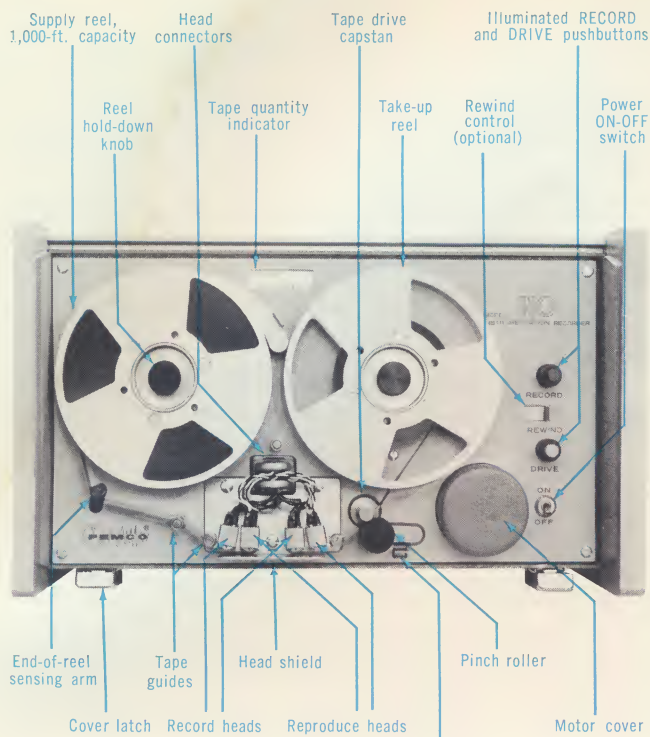
Record and reproduce amplifiers are readily accessible for changing plug-ins, or with an extender board, for checking calibration.

ment requires the reference track for operation of their servo "speed-lock" tape-speed-control systems.

Electronic assemblies All-transistor etched-circuit electronics have proved their reliability and stability in literally hundreds of applications of the Model 110 recorder/reproducer. Speed-sensitive elements which must be changed for various speeds are plugged into the circuit boards. These elements include FM-center-frequency oscillators, FM-reproduce filters, and direct-reproduce equalizers. Separate reproduce-head preamplifiers are located close to the heads for optimum signal-to-noise ratio. All other electronics, including the card housings, are of plug-in construction to simplify servicing. Direct and FM amplifiers must be inserted into the correct positions for recording and reproducing, but incorrect installation of a record amplifier into a reproduce slot will not cause damage, or vice-versa.

Signal and power connections Signal, power, and remote-control connections are to a panel at one end of the recorder. Input is through standard low-noise silver-plated BNC connectors. Power input and remote-control connections are through a Deutsch connector. A mating power connector is supplied with each recorder; additional connectors are available as standard items.

Connector-panel test points permit observing record current, bias levels, and FM center frequencies for installation and check-out of the instrumentation system. Adjustments are made through an access panel at the opposite end of the recorder. A BIAS DISABLE switch facilitates quick calibration of direct-recording tracks.



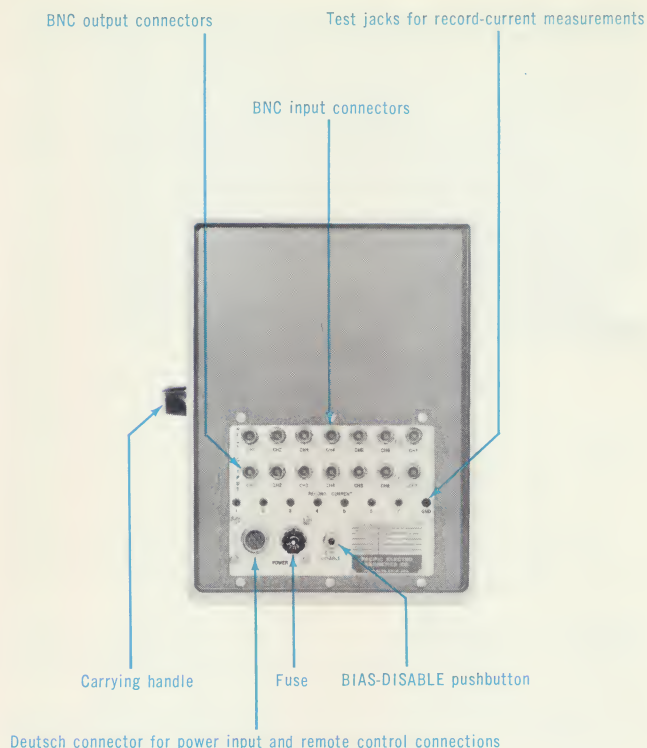
Pinch-roller control lever, can be solenoid-operated as optional feature

TOP VIEW: Cover removed

Record Interlock To avoid inadvertently recording over previously obtained data, a record-interlock system is standard on all Model 110's. Two push-buttons, RECORD and DRIVE, must be operated simultaneously to activate the recording circuits. The controls glow when actuated and their colored glow is visible through the recorder cover windows. Recording is automatically stopped and the recorder is switched out of the RECORD mode whenever power fails or the unit is switched OFF, end of tape is reached, or the pinch roller is disengaged. Both switches must be operated together to place the recorder in the RECORD mode again.

Low power requirement Only 30 watts of 28-volt DC or 35 watts of 117-volt AC are required by the Model 110 in a typical 1/2-inch-tape system. These minimum requirements simplify field and mobile test-installation requirements by eliminating the need for large generators, inverters, or power supplies. Standard DC units operate from 28-volt DC. Standard AC units operate from 117-volt, 60-cycle AC. DC models are operable from 12-volt DC or 117- or 220-volt 50/60/400-cycle AC with recorder-mounted accessory power supplies, or directly from a rechargeable power pack which provides at least three-hours operation. Both DC power supplies are current-limited to allow shorting of the output without damage. A continuous fault or short circuit opens a front-panel fuse.

Remote control units Remote control switch boxes are available from Pemco, but many users prefer to make their own for compatibility with the connectors and appearance of their other test items. Accessory remote-control devices can be provided



END VIEW

with the 110 to fit your specific test needs. These boxes have been supplied to include RECORD and DRIVE switches and indicators, power ON-OFF, pinch-roller switch, tape-quantity meters, end-of-tape indication, and automatic sequential operation of two recorders.

Compact, lightweight Extremely compact and lightweight, the recorder measures only 5 1/2 x 7 7/8 x 13 5/8 inches, and weighs only 17 pounds, including tape. These figures are for the minimum-size configuration of three channels of record and reproduce, or seven channels of record-only on 1/2-inch tape. The rugged aluminum carrying case is functionally designed to protect the recorder as it is carried or installed. The Model 110 can be mounted in any position, with or without the accessory shockmount.

Shipped ready to use Each recorder is checked out with its associated electronics and calibrated so that it is ready for use when it is packed for shipment. In addition, a comprehensive instruction manual, power cord, and amplifier extender board are supplied with each instrument.

Warranty and service Each Model 110 Recorder/Reproducer and its associated components and accessories is guaranteed against defects in material and workmanship for a one-year period. Service can usually be accomplished by technicians in your own facility. Or, it may be preferable to air-freight the small package to Pemco where it can usually be repaired and on a jet back to your facility within 48 hours. Critical spare parts are stocked by Pemco at all times; service and parts requirements are given top priority.

SPECIFICATIONS

GENERAL

- Size:** A — 3-ch rec/repro or 7-ch rec only on 1/2-in. tape:
5 1/2 x 7 7/8 x 13 5/8 inches.
B — 7-ch repro only on 1/2-in tape:
7 x 7 7/8 x 13 5/8 inches.
C — 14-ch rec only on 1-in tape:
9 x 7 7/8 x 13 5/8 inches.
D — 7 ch rec/repro on 1/2 or 1-in tape:
11 x 7 7/8 x 13 5/8 inches.
E — 14 ch rec/repro on 1-in tape:
12 1/2 x 7 7/8 x 13 5/8 inches (with reproduce amps.
in auxiliary Model 20 reproduce unit).

- Weight:** A — 17 pounds complete with tape.
B — 18 pounds complete with tape.
C — 20 pounds complete with tape.
D — 22 pounds complete with tape.
E — 24 pounds complete with tape.

Power Consumption: 20 to 45 watts, depending on tape speed, tape width and type of power.

Input Power: *DC Models* — 28 V $\pm$ 15% [also operates from (a) 12 VDC with Model 12 DC Supply, (b) 115 or 230 V 50-400 cycle AC with Model 11A Wide Range AC-DC Converter, or (c) own power with Model 14 Rechargeable Power Pack]. Optional internal polarity inverter supplied for negative-ground DC power. *AC Models* 115 V $\pm$ 10% 60-cycle single-phase (50 and 400 cycle also available on special order).

Remote Control: Power ON-OFF and RECORD.

Temperature: Operating — 0°C to +55°C.
—40°C to +55°C (with optional heaters).
Storage — -50°C to +85°C.

Altitude: 70,000 feet (DC Models only).

Humidity: Up to 95% relative.

RFI: Certified to MIL-I-6181D and MIL-I-26600.

Shock & Vibration: Suitable for use in most mobile, portable, and airborne environments. Optional MIL-C-172C shockmount supplied for severe environments. Consult factory with details of specific applications.

Operating Position: Any plane.

Connections: *Power and Remote Control* — Deutsch DM series connectors which meet or exceed MIL-C-26482.

Signals — BNC series connectors.

Enclosure: Rugged aluminum carrying case fully protects recorder in any position. Optional rack mount adapter allows installation of Model 110 in standard rack cabinets.

TAPE TRANSPORT

Tape Width: 1/2" or 1" (1/4" available on special order).

Tape Speeds: 15/16, 1 7/8, 3 3/4, 7 1/2, 15, 30 and 60 ips.
DC Models — Available with any two adjacent speeds between 1 7/8 and 60 ips with standard drive system. Three- or four-speed combinations and 15/16 ips also available with special drive systems. Speed selection by switch and/or belt change. Maximum speed range is 16:1.

AC Models — Available with any two speeds between 3 3/4 and 30 ips with standard drive system. Three-speed combinations and 15/16, 1 7/8, and 60 ips also available with special drive systems. Speed selection by belt change. Maximum speed range is 4:1 or 8:1, depending on speeds involved.

Tape Speed Accuracy: *DC Models* — $\pm$ 0.50% long term.
AC Models — $\pm$ 0.25% long term.

Tape Speed Stability: *DC Models* — $\pm$ 0.20% over a full reel of tape at any given speed.
AC Models — $\pm$ 0.10% over a full reel of tape at any given speed.

Reels: PEMCO precision 5" diameter, supplied for 1/4", 1/2", and 1" tape; hold 1000 ft. of 3M type 591 tape or equivalent.

Record Time: * 3.3 minutes at 60 ips.
6.6 minutes at 30 ips.
13 minutes at 15 ips.
26 minutes at 7 1/2 ips.
53 minutes at 3 3/4 ips.
106 minutes at 1 7/8 ips.
213 minutes at 15/16 ips.

* Based on 1000 ft. of 3M-591 or equivalent.

Controls: Toggle switch for POWER ON-OFF, lighted pushbuttons for RECORD and DRIVE. Manually engaged pinch roller (lighted pushbutton control for optional solenoid-actuated pinch roller available on DC Models — may be operated remotely). Optional rewind is manually actuated.

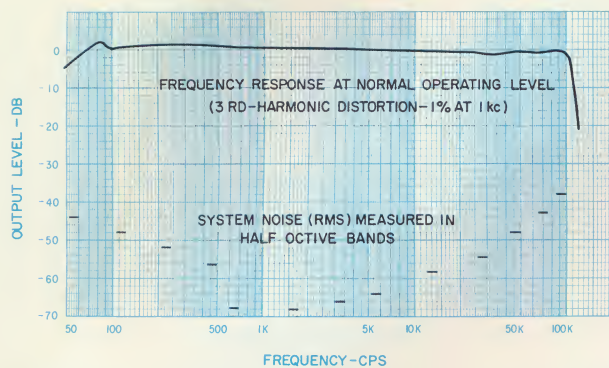
Start Time: *DC Models* — Stable tape motion in less than 1 second at 15/16 ips to 15 ips; less than 3 seconds at 30 ips; and less than 5 seconds at 60 ips. Start/stop time is less than 1/2 second at speeds of 15 ips and below with optional solenoid-actuated pinch roller available on DC Models.

AC Models — Stable tape motion in less than 5 seconds at 15/16 ips to 15 ips; less than 8 seconds at 30 ips; and less than 15 seconds at 60 ips.

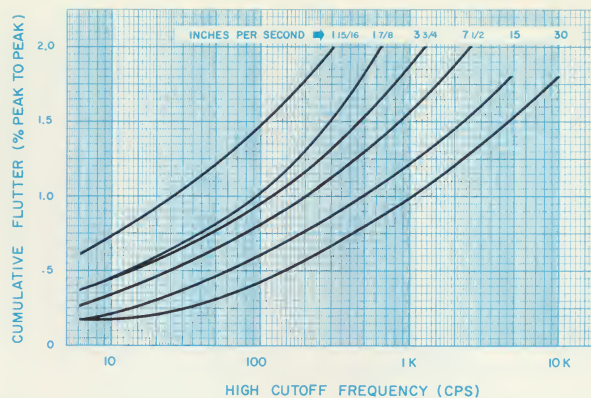
Flutter: Less than 2.0% peak-to-peak, cumulative from 0.2 cps to 10KC at 30 ips.

End of Tape Sensing: Spring-loaded tape guide next to the supply reel shuts-off all recorder functions when the end of the tape is reached (or in the unlikely event of tape breakage). Alternate airborne end-of-tape sensor operates from tape-follower arm and retains the last few feet of tape on the supply reel.

Heads: 3, 4, 7, or 14-track self-locating plug-in head assemblies conform to IRIG standards for track widths, spacings, numbering and tolerances. Record head gap trailing edges and reproduce head gap centerlines are held within a 100 micro-inch band, and this band (all stacks) is held perpendicular to the head baseplate within $\pm$ 1 minute of arc. Stack-to-stack spacing, where applicable, is 1.5" $\pm$ 0.0005". Other heads are available on special order.



Typical 30 ips direct frequency response and system noise.



Flutter data obtained from production Model 110 with data recorded and reproduced at the same speeds.

DIRECT RECORD/REPRODUCE SYSTEM

FREQUENCY RESPONSE RECORD/REPRODUCE

Tape Speed	Data Bandwidth ± 3 db	S/N Ratio
60 ips	300 cps-100 kc-IRIG	40 db
60 ips	100 cps-100 kc-IRIG	37 db
30 ips	100 cps-100 kc-EB	32 db
30 ips	300 cps-100 kc-EB	35 db
30 ips	300 cps- 50 kc-IRIG	40 db
30 ips	100 cps- 50 kc-IRIG	37 db
15 ips	100 cps- 50 kc-EB	32 db
15 ips	300 cps- 50 kc-EB	35 db
15 ips	300 cps- 25 kc-IRIG	40 db
15 ips	100 cps- 25 kc-IRIG	37 db
7 1/2 ips	100 cps- 25 kc-EB	32 db
7 1/2 ips	300 cps- 25 kc-EB	35 db
7 1/2 ips	300 cps- 12 kc-IRIG	40 db
7 1/2 ips	100 cps- 12 kc-IRIG	37 db
3 3/4 ips	100 cps- 12 kc-EB	32 db
3 3/4 ips	300 cps- 12 kc-EB	35 db
3 3/4 ips	300 cps- 6 kc-IRIG	40 db
3 3/4 ips	100 cps- 6 kc-IRIG	37 db
1 7/8 ips	100 cps- 6 kc-EB	32 db
1 7/8 ips	300 cps- 6 kc-EB	35 db
1 7/8 ips	300 cps- 3 kc-IRIG	40 db
1 7/8 ips	100 cps- 3 kc-IRIG	37 db
1 5/16 ips	100 cps- 3 kc-EB	32 db
1 5/16 ips	300 cps- 3 kc-EB	35 db

IRIG = Telemetry standards

EB = Extended-bandwidth specification

Input Sensitivity: 100-millivolts rms to 10-volts rms.

Input Impedance: 50,000 ohms, minimum.

Bias Frequency: 500 kilocycles $\pm 0.5\%$.

Output Voltage: 2-volts rms, maximum, into 1,000 ohms.

Output Impedance: 10 ohms in series with 35 microfarads.

Equalization: Plug-in speed-sensitive elements.

Cross Talk: Direct-to-direct is 40 db from 100 cps to 50 kc; 35 db from 50 kc to 100 kc.

Distortion: 1% third harmonic distortion at 1 kc and 2-volts rms into a 1000-ohm load.

Pemco reserves the right to change specifications without notice and without obligation. All system specifications are conservative and have been obtained with 3M-591 magnetic tape.

FM-CARRIER RECORD/REPRODUCE SYSTEM

FREQUENCY RESPONSE RECORD/REPRODUCE

Tape Speed	Center Carrier Frequency	Data Bandwidth $\pm 1/2$ db	Signal-to-Noise Ratio*
60	54 kc IRIG	dc-10 kc	40 db
30	54 kc EB	dc-10 kc	40 db
30	27 kc IRIG	dc-5 kc	40 db
15	27 kc EB	dc-5 kc	40 db
15	13.5 kc IRIG	dc-2.5 kc	40 db
7 1/2	13.5 kc EB	dc-2.5 kc	38 db
7 1/2	6.75 kc IRIG	dc-1.25 kc	38 db
3 3/4	6.75 kc EB	dc-1.25 kc	36 db
3 3/4	3.37 kc IRIG	dc-625 cps	36 db
1 7/8	3.37 kc EB	dc-625 cps	35 db
1 7/8	1.68 kc IRIG	dc-312 cps	35 db
1 5/16	1.68 kc EB	dc-312 cps	32 db

IRIG = Telemetry standards

EB = Extended-bandwidth specification

DC Drift: Overall system d-c drift is less than 2% of normal maximum peak-to-peak deviation for a temperature change from 0°C to 55°C and/or a 10% change in supply voltage over a 24-hour period. Short-term drift is less than 0.1% over a full reel of tape in a stable environment.

Polarity: A positive input signal produces an increasing frequency.

DC Linearity: Overall system linearity at 15 and 30 ips is within 2% of best straight line. At speeds below 15 ips overall linearity is within 1% of best straight line. In no case shall record non-linearity exceed 1/2 of system linearity.

Sensitivity: Adjustable: 0.5 to 10 volts for 40% deviation.

Distortion: Less than 1% total harmonic distortion.

Input Impedance: At least 20,000 ohms unbalanced to ground.

Overshoot: 10% maximum in maximum flat-amplitude response, and 1.5% in maximum flat-time response. Measurements made with output filter terminated in 10,000 ohms and not more than 20 mmf. cable capacitance.

Output Voltage: At least 1-volt rms for 40% deviation into a 10,000-ohm load.

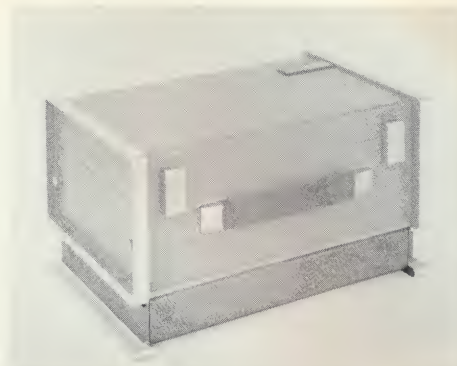
Cross Talk: 40 db.

NOTE: FM-reproduce amplifier must be terminated with a 10,000-ohm load.

* Optional flutter compensation, which requires one track on the tape, improves these S/N ratios approximately 6 db.



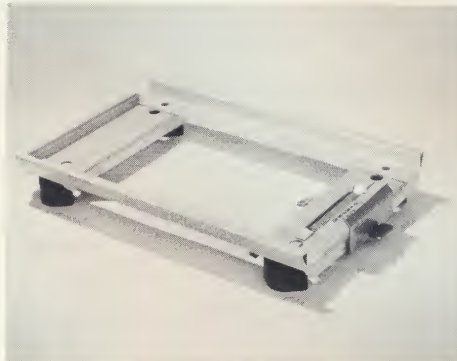
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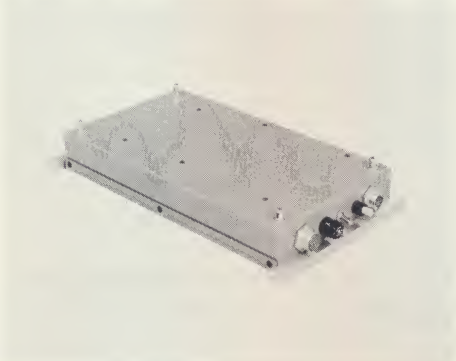
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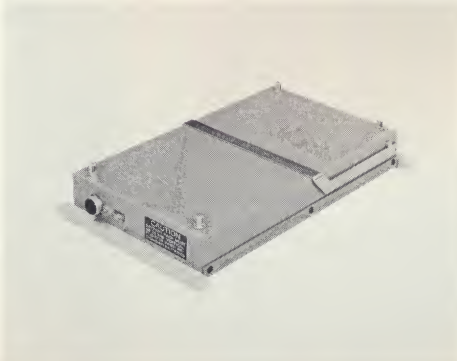
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ACCESSORIES

1. Model 10 Tape Spooler — Facilitates easy loading or unloading of Pemco 5-inch reels from standard 10.5-inch or 14-inch NAB reels. It is also useful for rewinding Pemco reels, especially where the user is recording on the Model 110 and reproducing the tape on other laboratory recorders. Size: $8\frac{1}{2} \times 9\frac{1}{2} \times 17$ inches. Weight: $16\frac{1}{4}$ pounds. Power: 105-125 V, 50/60 cps AC — 150 watts.

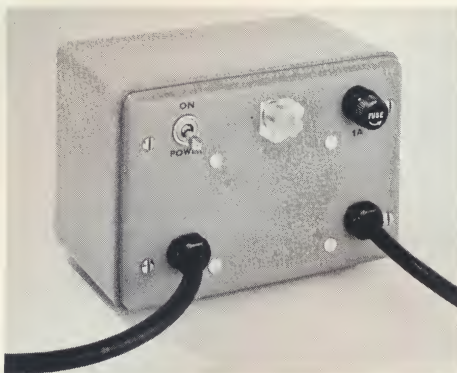
2. Model 11 AC-DC Converter — Converts 105-125 V, 50-400 cycle AC to 24-32 VDC, enabling DC Model 110's to be operated from standard AC power. Does not attach to recorder. Size: $3\frac{3}{4} \times 4\frac{1}{4} \times 6\frac{1}{4}$ inches. Weight: $4\frac{1}{4}$ pounds. Power: 105-125 V, 50-400 cps AC — 65 watts.

3. Model 11A Wide-Range AC-DC Converter — Conveniently attaches to the bottom of DC Model 110's to convert 85 to 130 V or 170 to 260 V, 50 to 400 cycle AC to regulated 28 VDC. Permits operation from a wide range of standard AC power. Especially useful where 110 is battery powered in the field and operated from AC in the laboratory. Adds $1\frac{3}{4}$ inches to height of Model 110; can be used with accessory shockmount. Size: $1\frac{7}{8} \times 7\frac{7}{8} \times 13\frac{5}{8}$ inches. Weight: 7 pounds. Power: 85-130 or 170-260 V, 50-400 cps AC — 60 watts.

4. Model 12 DC Power Supply — Conveniently attaches to the bottom of DC Model 110's to convert $12 \text{ V} \pm 10\%$ DC to regulated 28 VDC. Permits operation of DC models from standard auto batteries. Adds $1\frac{3}{4}$ inches to height of Model 110; can be used with accessory shockmount. Size: $1\frac{7}{8} \times 7\frac{7}{8} \times 13\frac{5}{8}$ inches. Weight: 7 pounds. Power: 12 VDC — 70 watts.

5. Model 13 Shockmount — Helps to protect the Model 110 from the effects of shock and vibration in severe environments. Made to MIL-C-172C, it permits rapid recorder attachment. Accepts Model 110 recorders with accessory Models 11A, 12, or 14 attached. Used in any plane. Recommended for all airborne and vehicular applications. Adds $1\frac{1}{4}$ inches to Model 110 height, not including any attached accessories. Size: $1\frac{1}{2} \times 8\frac{3}{4} \times 15$ inches. Weight: $1\frac{1}{2}$ pounds.

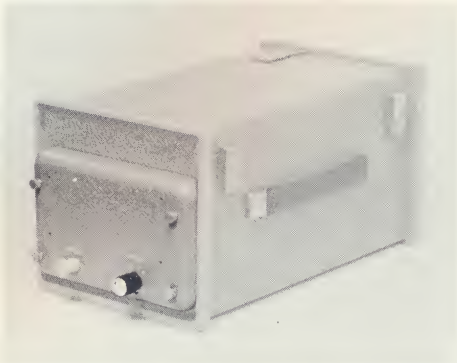
6. Model 14 Rechargeable Power Pack — Conveniently attaches to the bottom of DC Model 110's to eliminate the need for an external power source. Rated at 4.5 ampere-hours; nominal run time per charge is 3 to 4 hours, depending on speed. Supplies nominal 26.4 VDC and is rechargeable up to 1,000 times over a three-year wet life in normal use. Color-coded meter shows charge state at all times. Built-in stand supports unit in proper position for recharging. Adds $1\frac{3}{4}$ inches to Model 110 height. Size: $1\frac{7}{8} \times 7\frac{7}{8} \times 13\frac{5}{8}$ inches. Weight: 8 pounds.



7.



10.



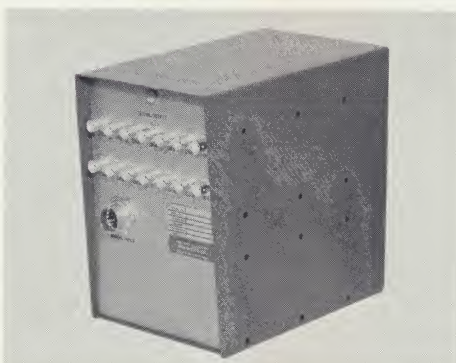
8.



11.



9.



12.

7. Model 15 Power Pack Charger — Provides simple controlled recharge of the Model 14 Power Pack. Nominal recharge time is 12 to 15 hours, programmed from 0.4-amp charging rate at the start to 0.1 amp at full charge. Output cable attaches to the Model 14's mating connector.
Size: $3\frac{3}{4} \times 4\frac{1}{4} \times 6\frac{1}{4}$ inches. Weight: $4\frac{3}{4}$ pounds.
Power: 105-125 V, 50/60 cycle AC — 25 watts.

8. Model 16 Switchable Reproduce Unit — Attaches to one end of the Model 110 over the amplifier-access opening. Holds one or two reproduce amplifiers to permit monitoring data recorded on any track. Output can be observed with an oscilloscope or VTVM. Especially useful for applications requiring field-monitoring capability and minimum size. Adds $2\frac{1}{4}$ inches to Model 110 length.
Size: $2\frac{5}{8} \times 4\frac{3}{4} \times 7\frac{1}{2}$ inches. Weight: $\frac{1}{2}$ pound.
Power: Connects to recorder power inside recorder.

9. Model 17 Tape Degausser — Provides a simple and convenient means of degaussing reels of tape prior to recording new data, either to erase old data or to ensure clean tape prior to use.
Size: $3\frac{3}{4} \times 5\frac{1}{4} \times 7$ inches. Weight: $7\frac{3}{4}$ pounds.
Power: 105-125 V, 50/60 cycle AC — 500 watts.

10. Model 18 Microphone — Provides a simple means of making a voice record of significant events during data

acquisition on one track. Noise-cancelling microphone contains built-in solid-state preamplifier and replaceable mercury battery. Cable has a BNC connector for attachment to either a Direct or FM channel with approximately 2,500-cps response.

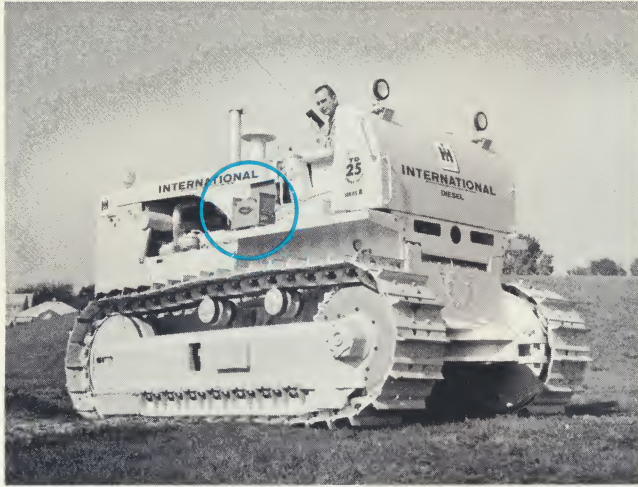
Size: $2\frac{1}{2} \times 2\frac{3}{4} \times 3\frac{3}{4}$ inches. Weight: 1 pound.
Power: Supplied by internal mercury cell.

11. Model 19 Auxiliary 7-Channel Reproduce Unit — A compact enclosure for housing up to seven reproduce amplifiers; has individual BNC output signal connectors and a connector for a cable leading to the reproduce preamplifiers in a Model 110. Minimizes size of Model 110 needed for field data acquisition and provides full 7-channel record/reproduce capability.

Size: $4\frac{1}{8} \times 5\frac{5}{8} \times 8\frac{1}{2}$ inches. Weight: 4 pounds.
Power: Cable connection to recorder.

12. Model 20 Auxiliary 14-Channel Reproduce Unit — Similar to the Model 19, but holds 14 reproduce amplifiers.
Size: $5\frac{5}{8} \times 8 \times 8\frac{1}{2}$ inches. Weight: 6 pounds.

Instruction Manuals — Additional copies of the instruction manual can be ordered for shipment with your Model 110 Recorder. These are quite helpful where several groups will be using the recorder and for technician training in the calibration and operation of the equipment.



International Harvester Company's Construction Equipment Engineering Department uses a Pemco Model 110 recorder for speeding performance and developmental tests on their heavy equipment such as this TD-25 Crawler Tractor.



A 110 recorder captures physiological reactions while an astronaut and the recorder are subjected to violent maneuvers. Other airborne medical recordings tape pilot reactions during simulated combat missions. Over 30% of all Model 110's are used for in-flight instrumentation applications.



California Division of Highways uses a Pemco recorder for various programs relating to the safety and construction of freeways. Installation illustrated was used for establishing proper expansion-joint placement to reduce driver fatigue.

A partial list of Pemco recorder users indicates a wide diversity of application for this versatile instrument. Some facilities have several Model 110's in continuous use.

AEROJET-GENERAL CORPORATION
 BELL TELEPHONE
 BENDIX CORPORATION
 BOEING AIRPLANE COMPANY
 BRITISH ROYAL NAVY
 CALIFORNIA DIVISION OF HIGHWAYS
 EASTMAN KODAK
 FAIRCHILD AERIAL SURVEYS
 GENERAL DYNAMICS
 GENERAL MOTORS
 GOODYEAR AIRCRAFT
 GRUMMAN AIRCRAFT ENGINEERING
 HUGHES AIRCRAFT
 IBM
 INTERNATIONAL HARVESTER
 JET PROPULSION LABORATORY
 LAWRENCE RADIATION LABORATORY
 MONASH UNIVERSITY (Australia)
 N A S A
 NATIONAL BUREAU OF STANDARDS
 NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
 NORTH AMERICAN AVIATION
 PENNSYLVANIA STATE UNIVERSITY
 SANDIA CORPORATION
 SWEDISH ROYAL AIR FORCE
 SYRACUSE UNIVERSITY
 TEXAS INSTRUMENTS
 UNITED STATES AIR FORCE
 UNITED STATES ARMY
 UNITED STATES NAVY
 UNIVERSITY OF CALIFORNIA
 UNIVERSITY OF COLORADO
 UNIVERSITY OF HOUSTON
 UNIVERSITY OF WISCONSIN
 WESTON OCEANOGRAPHIC SYSTEMS



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